

NATURAL RESOURCES CONSERVATION SERVICE

VIRGINIA CONSERVATION PRACTICE STANDARD

SURFACE DRAINAGE, MAIN OR LATERAL

(Feet)

CODE 608

DEFINITION

An open drainage ditch constructed to a designed size and grade.

Consideration shall be given to possible damages above or below the point of discharge that might involve legal actions.

PURPOSE

This practice may be applied as part of a water management system to collect and convey excess surface or subsurface water.

CRITERIA

GENERAL

The design and installation shall be based on adequate surveys and investigations. Compliance with all applicable federal, state, and local regulations and ordinances is required. The landowner(s) shall be responsible for obtaining and complying with all applicable permits.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to ditches for disposal of surface and subsurface drainage water primarily collected by drainage field ditches and subsurface drains.

It provides minimum drainage requirements for multiple-purpose channels that provide drainage outlets for agricultural lands. Mains or laterals having a drainage area of more than 1 mi² must meet the stability and maintenance requirements of the Virginia Conservation Practice Standard *Open Channel* (Code 582). This standard does not apply to collection of water with a drainage field ditch. Virginia Conservation Practice Standard *Surface Drainage, Field Ditch* (Code 607) should be used for water collection.

Whether the outlet is by gravity flow or by pumping, the outlet shall be sufficient for the quantity and quality of water conveyed. When the outlet is pumped, the Virginia Conservation Practice Standard *Pumping Plant* (Code 533) shall be used.

Drainage Requirements

Mains and laterals shall be located and designed to serve as integral parts of a surface or subsurface drainage system that meets the conservation and landuse needs. The degree of drainage required by the crops shall be determined and expressed in terms of drainage coefficients or depth and spacing of drains.

DESIGN

Capacity

The ditch capacity shall be adequate to provide for the removal of excess water, based on climatic and soil conditions and the needs of crops. The required capacity shall be obtained by determining the watershed area; the required topographic, soil, and landuse information; and use of the appropriate drainage coefficient curves.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

The required capacity of open ditches for subsurface drainage in irrigated areas shall be determined by evaluating site conditions, including irrigation water deliveries, irrigation canal or ditch losses, soil stratification and permeability, deep percolation losses, field irrigation losses, subsurface drain discharge, and quantity of surface water to be carried by the drainage ditch.

The drainage curves in Chapter 14 of National Engineering Handbook, Part 650, Engineering Field Handbook, are to be used to determine the flow capacity of mains and laterals. Other methods are to be used only after approval by a TAST engineer.

Hydraulic Gradeline

The hydraulic gradeline for drainage ditch design shall be determined from control points, including elevations of significant low areas served by the ditch and hydraulic gradelines of any tributary ditches and the outlet. If control point elevations are estimated rather than computed from survey data, the hydraulic gradeline shall be no less than:

1. 1 ft. (0.3 m) below fields that will receive normal drainage from ditches draining more than 1 mi² (2.59 km²).
2. 0.5 ft. (0.15 m) for ditches draining 40 to 640 acres (0.16 to 2.59 km²).
3. 0.3 ft. (0.09 m) for ditches draining less than 40 acres (0.16 km²).

For lands to be used only for water-tolerant crops, such as trees and grasses, these requirements may be modified and the hydraulic gradeline set at ground level. These provisions do not apply to channels where flow is contained by dikes.

The effects of hydraulic losses caused by culverts, bridges, or other obstructions in the channel section shall be considered.

Depth

Drainage ditches shall be designed deep enough to allow for normal siltation. If needed, the design depth and capacity may be increased to provide adequate subsurface drainage or for normal flow. The increase shall be based on an evaluation of site conditions. Ditches that serve as outlets for

subsurface drains shall be designed for a normal water surface at or below the invert of the outlet end of the drain. Where site conditions allow, the clearance between a drain invert and the ditch bottom shall be least 1 ft. (0.3 m) for ditches that fill with sediment at a normal rate, except where lower values are specified for a job because of unusual site conditions. The normal water surface is the elevation of the usual low flow during the growing season.

Cross Section

The design ditch cross section shall be set below the design hydraulic gradeline and shall meet the combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, and, if needed, allowances for initial sedimentation. Side slopes shall be stable, shall meet maintenance requirements, and shall be designed on the basis of on-site conditions.

The drainage guide or other local information shall be used to determine side slope limits for specific soils and/or geologic materials. If such information is not available, the design side slopes in the main or lateral shall not be steeper than those shown in NEH, Part 650, Engineering Field Handbook, Chapter 14, Section 650.1412 (d). Stability during rapid drawdown conditions must be considered.

Velocity

The maximum permissible design velocity shall be based on site conditions and shall ensure stability of the ditch bottom and side slopes. Design velocities shall not be less than 1.4 ft/s (0.43 m/s) to avoid excessive sedimentation. Refer to Table 14-2 in the Engineering Field Handbook for maximum permissible velocities based on soil type. On flat grades, a channel cross-section shall be selected on the basis of the depth and maintenance requirements.

The velocity for newly constructed channels with drainage areas in excess of 1 mi² (2.59 km²) shall meet the stability requirements specified for Virginia Conservation Practice Standard, *Open Channel (Code 582)*.

Capacity Design

Manning's Formula shall be used in determining the design velocity, and the value of n shall be based on alignment, probable vegetative growth expected with normal maintenance, other roughness factors, and the hydraulic radius. Unless special site studies are available to justify other values, the following values of n , based on the hydraulic radius of the channel and assuming an aged channel with good maintenance and good alignment, shall be used in solving the Manning Formula for mains and laterals when determining required capacity.

Hydraulic radius	n
Less than 2.5	.040 — .045
2.5 to 4.0	.035 — .040
4.1 to 5.0	.030 — .035
More than 5.0	.025 — .030

Berms And Spoil Banks

Adequate berms shall be provided and shaped, as required, to provide access for maintenance equipment, to eliminate the need for moving spoil banks in future operations, to provide for work areas and facilitate spoilbank spreading, to prevent excavated material from washing or rolling back into ditches, and to lessen sloughing of ditchbanks caused by heavy loads too near the edge of the ditchbanks. The spoil shall be spread as soon as practical. The following minimum berm widths shall be provided, except where spoil is spread according to the Virginia Conservation Practice Standard *Spoil Spreading (Code 572)* for spoilbank spreading:

Ditch depth		Minimum berm width	
ft	m	ft	m
2--6	.6 -- 1.8	8	2.4
6--8	1.8--2.4	10	3.0
> 8	>2.4	15	4.6

If spoil material is to be placed in banks along the ditch rather than spread over adjacent fields, the spoilbanks shall have stable side slopes. Provision must be made to channel water through the spoil and into the ditch without causing serious erosion.

Related Structures And Ditch Protection

Mains and laterals shall be protected against erosion where surface water or shallow ditches enter deeper ditches. This may be achieved through the use of chutes, drop structures, pipe drops, other suitable structures, grassed waterway, critical area planting, filter strips, or specially graded channel entrances.

Grade control structures, bank protection, or other suitable measures shall be used if necessary to reduce velocities and control erosion.

Culverts and bridges shall have enough hydraulic capacity and depth for drainage needs and to minimize obstruction to flow.

Capacities of pipe or drop structures shall be determined by use of the applicable drainage coefficients. The "island-type" method of construction shall be used to protect the structure from washout by flows exceeding design capacity.

Each structure for an open ditch system shall be designed according to NRCS standards for the kind of structure and type of construction used.

Vegetation Establishment

The ditch bottom, side slopes, and other disturbed areas shall be established in permanent vegetation as soon as practicable after construction. Seedbed preparation, seeding, fertilizing, and mulching shall be appropriate for the site-specific conditions. Refer to the *NRCS Plant Establishment Guide for Virginia* Mixture Numbers 1 through 4 for allowable species, seeding mixtures, and recommended seeding dates. Other mixtures shall be used only with the concurrence of the TAST engineer.

The vegetation shall be maintained. Trees and shrubs shall be controlled by hand, machine, or chemicals, as necessary.

Environmental Concerns

Potential impacts to adjacent wetland areas must be addressed. USDA wetland conservation provisions apply. The practice must comply with NRCS wetland technical assistance policy contained in GM 190, Part 410.26.

Planning and implementation of this practice will be preceded by an environmental evaluation using the "Environmental Evaluation Data Sheet", Form VA-

608-VA-4

EE-1 and related guidelines found in GM-190, part 410 (Virginia Amendments).

CONSIDERATIONS

Consideration should be given to the effects on the water budget components, especially with regard to effect on runoff, soil water, and water tables.

Potential changes in soil moisture that will affect the growth of desirable vegetation should be evaluated.

Effects on groundwater recharge should be considered.

Consider the effects on the detachment and transport of sediment and chemicals and dissolved and sediment-attached substances into water courses.

Effects on the quality of groundwater should be evaluated.

Potential for changes in downstream water temperatures should be evaluated.

Downstream visual quality may be affected.

Impacts on cultural resources should be considered.

The need for riparian buffers, filter strips, and fencing should be assessed.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing mains or laterals shall be in keeping with this standard and shall describe the requirements for constructing the practice to achieve its intended purpose.

DESIGN DATA

A plan-profile drawing should be prepared for all jobs. Drawings will be prepared on standard sheets or state approved forms. When plan profiles are not required, information to support design will be recorded in the engineering field book or case file as appropriate. As a minimum, record and maintain the following planning and design data. Include this information on either the drawings, approved forms, or in the engineering field book, as appropriate:

1. Completed form VA-EE-1.
2. Location map. Include tract number, field number(s), and acreage in field(s). Include plan view of ditch(es) in relation to an identifiable point.
3. Drainage area, soil type drained, and drainage coefficient.
4. Computed design velocity.
5. Design grade, bottom width, average depth, side slopes, hydraulic gradient, and berm width for each design section of new ditch(es).
6. Method of spoil disposal.
7. Group jobs require a drainage area map showing the location of ditches, apparent property lines and ownership along the works of improvement.
8. Engineering Layout Surveys.
9. Structures, where applicable.
10. Soil borings, where applicable.
11. Yardage calculations when needed for performance certification.
12. Outlet conditions.
13. Cross-references to appropriate engineering field books will be made on drawings and plans.
14. Recommendations for channel vegetation.

The following five general paragraphs may be used, as written, to supplement site-specific specifications where applicable:

Clearing

The channel area shall be cleared of trees, logs, stumps, and other materials necessary for construction. Care must be taken to protect all trees to be saved for environmental purposes. All material shall be disposed of by an acceptable method as shown on the plans.

Excavation

Channels shall be excavated to line and grade as shown on the plans or as staked in the field. The excavated surface shall be reasonably smooth. Construction activities shall be carried on in a manner that will not restrict flow from upstream channels. Care must be taken to reduce and prevent pollution of water.

Spoil

Spoil shall be disposed of as shown on the plans or as marked in the field.

Structures

All structures and other related protection devices shall be installed as the work progresses to permit proper functioning of the ditch and to prevent environmental damage during the installation period.

Vegetation

Vegetation shall be planted at times and rates shown in the plans or in the specifications for each job.

CHECK DATA

As a minimum, record and maintain the following check data:

1. For each design section, record cross-section notes to show grade, bottom width, top width, depth, side slopes, berm width, and spoil banks, if specified. Uniformly sized parallel lateral ditches require a typical cross-section, plan view sketch of ditches on plan map, and ditch length paced or scaled from photographs.
2. Length of all ditches installed
3. Data on all structures installed
4. Adequacy of outlet

5. Certification that practice meets standards and specifications. Note any exceptions.
6. A statement that the following have been satisfactorily completed:
 - a) Spoil spreading
 - b) Seeding or successful establishment of vegetation
7. Operation and Maintenance Requirements.

All field survey notes and construction check data will be recorded in a standard engineering field book or other approved forms in accordance with Technical Release 62 and Chapter 1, Engineering Field Handbook.

OPERATION AND MAINTENANCE

Operation and Maintenance requirements shall be established to maintain the ditches installed under this standard. Maintenance needs are to be discussed with the landowner or operator who is responsible for maintaining the practices installed under this standard.

Requirements for operating and maintaining all drainage mains and laterals having drainage areas in excess of 1 mi² (2.59 km²) shall be according to the Virginia Conservation Practice Standard, *Open Channel (Code 582)*.

Ditches shall be maintained by:

- Keeping channels clean and free of materials that can reduce the flow.
- Repairing eroded areas as necessary.
- Inspecting side slopes to ensure stability is maintained. Reshape and re-seed slopes as necessary.
- Checking outlet to ensure free flow and a stable outlet condition.

REFERENCES

1. National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 1,

Engineering Surveys and Chapter 14, Drainage.

2. Technical Release 62, Engineering Layout, Notes, Staking and Calculations, January 1979.
3. *Plant Establishment Guide for Virginia*.
4. NRCS, Virginia Field Office Technical Guide.
5. General Manual, 190, Part 410, Compliance with NEPA (Virginia Amendments).

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Approved Practice Narratives

(Feet)

CODE 608

608 D1 Surface Drainage, Main or Lateral:
Establish and maintain ditch(es) in accordance with
this standard and any design(s) or specification(s)
provided.

608 D2 Surface Drainage, Main or Lateral:
Maintain existing ditch(es) in accordance with this
standard and any design(s) or specification(s)
provided.

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